RCS Residential Control Systems Inc.

Model TXB16

X10 Powerline Communicating Thermostat

INSTALLATION AND OPERATION MANUAL

Rev D Control Unit

DCN: 141-00940 Rev 07
10/01/04

Applies to the following product revisions or later:

Product	Part No
TXB16 Thermostat Kit	001-00940-10
TS16 Wall Display Unit	001-00910-09
HCUXE HVAC Control Unit (Rev D)	001-00376-09

***** IMPORTANT NOTICE *****

DO NOT USE THIS PRODUCT FOR BUILDING FREEZE PROTECTION! YOU ARE ADVISED TO INSTALL A MECHANICAL FREEZE PROTECTION DEVICE FOR THIS PURPOSE.

TXB16 OPERATION

The TXB16 thermostat provides the latest technology in a full-featured universal thermostat with X10 Power Line communications. The TXB16 has many new features including:

- Separate Heating and Cooling Setpoints
- Multistage HVAC Systems Support
- Setup Mode from the Wall Display Unit
- Automatic Remote Sensor Detection
- Status LED X10 Signal Indication
- Selectable X10 Decode Table
- Bi-directional X10 Standard
- Enhanced X10 Protocol

The TXB16 thermostat consists of two parts, a **TS16 Wall Display Unit (WDU)** and a **HVAC Control Unit.** The Wall Display Unit provides users functions like a traditional thermostat and connects to the Control Unit by a 4 wire cable. The Control Unit connects at the HVAC system using the standard thermostat connections and provides the thermostatic temperature control of the system. The Control Unit also has the X10 Power Line Interface connection.

The TXB16 now maintains separate heating and cooling setpoints and you can select single or dual setpoint operation. The display shows the setpoint of the current system mode (Heat or Cool). In the Off or Auto mode, the system keeps track of the current operating mode of the last call, either heating or cooling. ***Single setpoint commands are still used to send and request setpoint information.*** When a new setpoint is sent to the TXB16, it will automatically convert that setpoint into a heating or cooling setpoint based on the current operating mode of the stat. This allows compatibility with single setpoint systems. When Autosend in enabled, it will report a setpoint change as either a heating or a cooling setpoint with new X10 Bi-directional messages.

In addition to the universal Standard or Heat Pump HVAC system type support, the TXB16 supports multistage heating/cooling system outputs. The control unit can support 2 stages of heating and cooling for Standard systems, or 3 stages of heating and 2 stages of cooling for Heat Pump systems.

The TXB16 has a convenient setup mode from the Wall Display Unit. You can set the X10 House code address, the F or C temperature mode and easily calibrate the internal and remote sensors.

The TXB16 has automatic detection and setup of remote temperature sensors. Remotes sensors have 3 address settings that, when detected by the TXB16, will be used for specific functions such as in lieu of the internal sensor, averaging with other sensors or an outdoor sensor.

The Status LED shows X10 signal traffic, which can be helpful in trouble shooting system installation problems. The Status LED flashes slowly to indicate system OK. When an X10 command is received, normally the Status LED will blink fast 2 times. If the command is addressed for this thermostat, the LED will flash fast 4 times. X10 transmissions will also flash the LED.

The TXB16 supports all of the RCS X10 Unit Code and Bi-directional protocols.

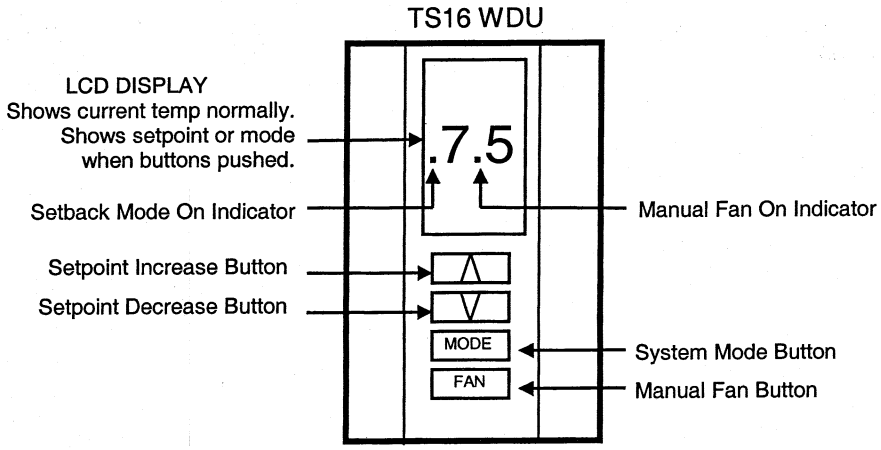
The TXB16 supports the RCS Unit Code "B", "P" and "L" decode tables as well as the bi-directional "Preset Dim" table. The default X10 Unit Code decode table, B or P, can be set to allow compatibility with existing TX15/TX15-B thermostats and control software. Changes in decode table selection by using "All lights On" or "All Units Off" commands or Preset Dim Commands are now stored in permanent memory.

Remote control of the TXB16 via the robust X10 Bi-directional communications protocol allows for the thermostat's temperature, heating and cooling setpoints, operating mode and fan functions to be monitored or changed.

Many new commands have been added to support the TXB16's new features. Refer to the X10 protocol document, DCN 150-00200.

The TS16 Wall Display Unit has a LCD display and control buttons for changing the setpoint, system operating mode and manual fan mode. The WDU also has an internal temperature sensor. The display serves as a common display for many functions. It normally shows the current room temperature but switches to show setpoint, mode or other functions when buttons are pushed. Two on-screen indicators show the state of the manual fan and setback mode.

Any changes, such as the temperature or control button operations at the WDU are sent to the HVAC Control Unit. In turn, the Control unit can send changes in setpoint or modes up to the WDU. When updates are received, they are displayed on the LCD for 3 seconds and then the display returns to the current room temperature.



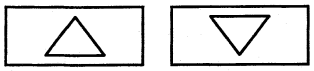
LCD Display

The LCD display is a two digit multifunction display that normally shows the current room temperature. It has a continuous backlight for easy viewing anytime. Whenever any of the control buttons are pushed, the LCD display will change to show that function's current status. The LCD display will stay in the new display mode as long as buttons are being pushed. After 3 seconds of no activity, the display will change back to show current temperature.

The right decimal point on the LCD display will turn on whenever manual fan is ON. The left decimal point will flash whenever the setback mode is ON.

Remote changes in setpoint or modes that are received from the Control Unit will cause the LCD display to switch and display the updated data for 3 seconds and then return to current temperature.

Control Buttons



UP – DOWN Buttons

The **UP** and **DOWN** buttons control the setpoint temperature. Pushing the **UP** or **DOWN** button **once** will cause the LCD display to change to **show** the current setpoint temperature (but won't change it). Pushing the button again, before the display switches back to current room temperature, will decrement or increment the setpoint value by one degree. Pushing and holding a button down will cause the setpoint to continuously ramp up/down until the button is released. After 3 seconds of no activity, the LCD display will change back to show the current room temperature and the new setpoint value will be sent to the Control Unit.

The max cooling setpoint is 110 deg F (43 deg C). The max heating setpoint is 106 (41 deg C).
Min setpoint is 40 deg F (5 deg C) for heating and 44 deg F (7deg C) for cooling.

Setpoint Display

The displayed setpoint shows the setpoint of the **current operating mode** (heating or cooling) of the system. If you change modes, the setpoint displayed will change to the new operating mode setpoint.

If you set the mode to AUTO mode, the setpoint displayed will be the current operating mode of the system, either heating or cooling. This will change if the operating mode changes automatically.

MODE **MODE Button**

The **MODE** button controls the HVAC system mode. To see what mode the system is in, push the **MODE** button **once** and the LCD display will change to **show** the current mode (but won't change it). Pushing the **MODE** button again while the mode is being displayed, will cause the mode and display to change to the next mode. The system mode cycles from **Off** to **Heat** to **Cool** to **Auto (**and to **EH** or emergency heat for Heat Pump systems) and back to **Off** again with each push of the **MODE** button. Any change in the system mode will be sent to the HVAC Control Unit.

When Heat Pump HVAC system type is selected on the Control Unit, an additional system mode of **"EH"**, or Emergency Heat, is included in the TS16 mode selections. EH is used when Heat Pump compressor failure requires the use of Auxiliary Heat (heat strips) for primary heating. When EH mode is selected, the display will alternate between current temperature and "EH" to remind you that the EH mode has been selected. After the compressor repair is completed, return the mode to heating or cooling as needed.

FAN **FAN Button**

The **FAN** button controls the HVAC system's manual fan mode. Pushing the **FAN** button once will turn the fan **ON** and pushing it again will turn the fan to the **AUTO** mode (which is OFF unless the fan is automatically turned ON by the heating or cooling operation). The decimal point in the middle of the two digits on the LCD display will come on when the manual fan is ON. Changes in the fan mode will be sent to the HVAC Control Unit.

The Control Buttons can be used for other functions and in combinations.

- Press and hold the UP/DOWN buttons simultaneously to view the Outside temperature. (If an outdoor sensor is attached or network outside temperature data is available).
- Press the MODE button and simultaneously press the FAN button to enter the Setup Mode.
- Buttons are used for navigation in other modes.

Temperature Display

The WDU will normally display the current indoor temperature from the internal digital temperature sensor or a remote sensor with address 1. The sensors have an accuracy of +/- 1°F(+/- .5°C) and the range of -67°F(-55°C) to 257°F(125°C).

The WDU will display temperatures from -9°F/C to 127°F/C. Temperatures less than 0° will be displayed down to -9 ° (temperatures lower than –9 will also be displayed, but without the – sign). Temperatures over 100° will be displayed without the leading 1 (ex: 102 will be displayed as 02°)

Outside Temperature Display

If you attached a remote temperature sensor to the WDU that is set to remote sensor address "4", you can view the outside temperature by pressing the UP and DOWN buttons simultaneously.

Setup Mode

The TXB16 has a new setup mode to allow the user to set the following functions from the WDU:

- X10 House Code Address
- F/C mode
- Sensor Calibration

Entering into the setup mode.

Enter the setup mode by the following procedure:

1. First press and hold the Mode button
2. Simultaneously press the Fan button.
3. The display will change to show "SU".
4. Release all buttons.
5. The display will change to show the setup menu, starting with "Ad" (Address)
6. Select what setup function you want to change or view by pressing the Mode button to cycle through the menu options:
   "Ad" X10 Address
   "FC" Fahrenheit or Celsius mode
   "C1" Calibrate Internal Sensor (or Remote Sensor address 1 if attached)
   "C2" (if Remote Sensor address 2 attached)
   "C4" (if Remote Sensor address 4 attached)

Setting the Address

When you first enter the setup mode, the first menu selection displayed on the LCD display is "Ad". To view the current address setting, press the UP or DOWN button once. With the current address displayed, you can either change the setting or exit by pressing the mode button or wait for the screen to time out. If you want to change the address, while the current address is being displayed, use the UP/Down buttons to select the address desired, 1 to 16, corresponding to X10 house codes A to P. (Default set to 1 for HC A)

Setting the Fahrenheit or Celsius mode

In the setup mode, press the mode button to select "FC" mode. Press the UP/DOWN buttons to select F or C mode desired. To exit press mode again to move another setup mode or wait for the screen to time out and return to thermostat mode.

Setting the Sensor Calibration

In the setup mode, press the mode button to display the sensor calibration address, "C1", to be calibrated. "C1" is the internal sensor and normally that is all that will be available to calibrate unless external remote sensors are attached. These will show up as "C1", "C2" and "C4" in the menu selection, if present. With the desired sensor address displayed, press the UP/DOWN buttons to change the sensor calibration to the desired temperature. See calibration explanation below.

Exit setup mode

When you are done making changes and no button is pressed for 3 seconds, the display will automatically exit setup mode and return to the thermostat mode and current temperature display.

Temperature Display Calibration

The TS16 WDU has the capability for the user to adjust the temperature display calibration from the WDU in the setup mode of the internal sensor as well as all attached remote sensors.

Normally the TS16, with no attached remote sensors, will only show the internal sensor as "C1" in the calibration setup menu. The TS16 can have additional remote sensors attached. These are addressed as remote sensors 1, 2 (3 is not used on theTS16) and 4. If they are detected by the TS16, they will show up in the calibration menu as additional sensors to calibrate as C2 and C4. Note that if remote sensor with address 1 is attached it replaces the internal sensor and is becomes the "C1" sensor. See the remote sensor section for more details.

When the desired sensor is selected in the setup menu, you can adjust its displayed temperature calibration up or down 7 degrees by pressing the UP/DOWN buttons.

The calibration menu selections are:
C1 = calibrate internal sensor or remote sensor address 1 if attached
C2 = calibrate remote sensor address 2 (only shows up in menu if attached)
C3 = N/A, not used on the TS16
C4 = calibrate remote sensor address 4 (only shows up in menu if attached)

Remote Sensors

The TS16 Wall Display Unit has a remote sensor terminal block, J2, on the base for connection of a remote temperature sensor. Without any remote sensor attached, the WDU uses the internal sensor for the current temperature information. When a remote sensor is attached, the WDU will detect it *automatically* and will use the remote sensor(s) according to its address selection. Modes of operation are as follows:

Address 1: Use the remote sensor instead of internal sensor. (becomes C1 in the calibration setup).
Address 2: Average remote sensor 2 with internal sensor or remote sensor 1. (C2 in the calibration setup)
Address 3: Not used with the TS16
Address 4: This remote sensor is used for an ***outside*** temperature sensor. (C4 in the calibration setup)

Table of Remote Sensor Functions and Sensor Addresses

Function	Remote Addr 1	Remote Addr 2	Remote Addr 3	Remote Adrr 4
Use internal sensor only	No	No	Not used	*
Use remote sensor only	Yes	No	with TS16	*
Average internal and one remote	No	Yes		*
Average two remotes (only 2)	Yes	Yes		*
Outside temp display on WDU	NA	NA		Yes

* optional outside temp sensor can be used with any other sensor address.

When averaging sensors are used, the **average** temperature is displayed on the WDU and reported to the HVAC control unit. You cannot view an individual remote averaging sensor temperatures as the main thermostat display or report individual sensor temperatures on the communication port. However, you can check the individual sensor temperatures by going to the calibration setup menu and selecting the sensor address. You can view the outside temperature by pressing both the UP/DOWN buttons simultaneously.

WDU Error Displays

"CF" Error Display

If the WDU is not properly wired or if communications to the Control Unit is interrupted, the LCD display will display "CF" to denote communications failure. Momentary display of "CF" caused by bad or lost data, will clear automatically when data communications is restored.

If the "CF" display stays on, check wiring for problems. A continuous "CF" display may indicate a problem with the Control Unit or the WDU itself.

"SF" Error Display

If the WDU detects that a sensor is not responding, it will display "SF". In most cases this will clear itself when communications is restored to the sensor. A continuous "SF" display may indicate a problem with the wiring or the WDU itself. Check wiring and replace the WDU as needed.

"-- --" Error Display

This denotes that the temperature is invalid. Can appear if you select outside temperature and no remote sensor is attached or if an error in temperature is sensed momentarily by the WDU. Clears automatically when a valid temperature is read.

TXB16 HVAC Control Unit

The TXB16 HVAC Control Unit works in conjunction with the Wall Display Unit to provide thermostatic control of the HVAC system. In addition, the Control Unit can receive X10 commands for remote control of the setpoints, temperatures and modes of the thermostat. The TXB16 X10 bi-directional protocol also allows the unit to transmit information via the pre-set dim commands.

The TXB16 Control Unit connects to the HVAC system the same as, and in place of, a standard thermostat. It is usually mounted near the HVAC system, although it can be mounted anywhere convenient. It is connected to the WDU by a 4 wire cable, either standard thermostat wiring or typically Cat 3/5 in new construction.

Actual thermostatic control of the HVAC system is provided by the Control Unit. Changes in the current temperature, setpoint, system or fan modes are sent to the Control Unit either from the WDU or via X10 commands. The Control Unit monitors this information and operates the HVAC system accordingly.

HVAC System Compatibility

The TXB16 works with almost all heating and cooling systems, including standard Gas/Electric, Heat Pump, Radiant, or Hydronic systems and with single or multi-stage systems. Compatible with single or separate transformer heating/cooling systems.

System Type	Heating Stages	Cooling Stages	Notes
Gas	2	2	Single or split transformer
Electric	2	2	Selectable Fan with Heat
Heat Pump	3	2	Selectable Changeover with Heat or Cool
Radiant	2	2	
Hydronic	2	2	Pump output

STANDARD GAS/ELECTRIC HVAC SYSTEMS OPERATION

The TXB16 has Standard HVAC system operating modes of Heating, Cooling and Auto changeover.

In the **HEAT** mode, the stage 1 heating will be turned on at one degree below the heating setpoint and will turn off **at** the setpoint. In the **COOL** mode, the stage 1 cooling will be turned on at one degree above the cooling setpoint and will turn off **at** the setpoint. This is referred to as the setpoint Delta T (temp) mode of operation.

Second stage heating/cooling deltas are factory set at 3 degrees. This means that second stage will come on when the delta from setpoint reaches 3 degrees. Second stage heating/cooling calls will stay on until the first stage setpoint is satisfied.

Optional Delta T mode of operation. In addition to the normal mode of operation described above, there is an alternate mode of operation available. In this mode, the Heating call comes on at one degree below setpoint as usual but won't go off until ***one degree above setpoint***. Cooling calls work similarly. This mode increases the temperature swing to 2 degrees and reduces system cycling. This optional mode of operation is enabled with Dipswitch SW1 position S5 on the control unit circuit board. NEW!

In the **AUTO** mode, the system will maintain the heating or cooling setpoints and switch automatically from heating mode to cooling mode as needed. There is a ***deadband*** between heating and cooling setpoints that keeps the two setpoints from overlapping. This is set to 4 degrees.

Setpoint Push. If you adjust the heating setpoint to be less than 4 degrees from the cooling setpoint, the cooling setpoint will be ***pushed*** to maintain the 4 degree deadband separation. Same for adjusting the cooling setpoint, if you get within the deadband separation, the heating setpoint will be pushed.

Minimum run time (MRT). The HVAC Control Unit has a minimum run time set to 6 minutes. Whenever a heating or cooling call turns on, the system will run a minimum of 6 minutes even if the call is satisfied before then. ***If the system is set to Off mode, the MRT will be canceled and all operation stopped.***

Minimum Off Time (MOT). The HVAC Control Unit has a short cycle protection (SCP) delay of 6 minutes after any compressor operation. This delay prevents a subsequent compressor call until the delay times out. This delay is to allow the compressor head pressure to bleed off before starting again. In addition, at the end of every heating or cooling call the MOT is triggered to prevent rapid cycling of the system.

NOTE: The Status LED on the Control Unit circuit board will change to flash twice to indicate the system is in a MRT or MOT delay period.

Standard HVAC System Setup

Standard System Mode Selection. To set the Control Unit for standard GAS/ELECTRIC operation, set the dipswitch SW1 position 1 to the STD SYS position (SW1-1 = OFF).

Fan Mode Selection. Normally, GAS heating systems DO NOT require fan calls along with the heat call due to automatic fan operation in the furnace. For Gas systems, dipswitch SW1 position 2 should be set to the STD FAN position (SW1-2 = OFF).

Electric and hydronic heating systems generally DO require that a fan call be generated along with the heat call. For these systems, dipswitch SW1 position 2 should be set to the FAN/HEAT position (SW1-2 = ON). Be sure to check your HVAC system's requirements.

Note: Dipswitch SW1 position 3, the CO selection is not required for standard systems. Leave in the Off position (SW1-3 = OFF)

TXB16 Control Unit HVAC System Outputs for Standard Systems

Operating Mode	Outputs (no Fan with Heat)	Outputs (Fan with Heat)
Manual Fan	G	G
Heating Stage 1	W1	W1, G
Heating Stage 2	W1, W2	W1, W2, G
Cooling Stage 1	Y1, G	Y1, G
Cooling Stage 2	Y1, Y2, G	Y1, Y2, G

HEAT PUMP HVAC SYSTEM OPERATION

The TXB16 has Heat Pump operating modes of Heating, Cooling, Auto changeover and Emergency Heat.

The Heat Pump HVAC system operation is the same as for Standard systems for normal first and second stage operations. In addition, Heat Pumps may have a third stage of heating, which is for heat strips. The third stage comes at 5 degrees from setpoint and stays on until the stage 1 setpoint is satisfied.

Emergency Heat Mode. When the Control Unit is selected as a Heat Pump system, there is an Emergency Heat Mode that can be selected from the WDU mode menu. In the event of a compressor failure, the "EH" mode can be selected. When in this mode, the heat strips (W1 output) will be used for stage one heat calls. This mode is for temporary use until the compressor can be repaired.

Heat Pump systems have the same Minimum Run Time and Short Cycle Protection /Minimum Off Time delays as Standard systems.

Heat Pump systems have a different HVAC system setup, which is described below.

Heat Pump HVAC System Setup

Heat Pump Mode Selection. For Heat Pump operation, set SW1-1 to the HP SYS position (ON).

Fan Mode Selection. Set the Fan selection, SW1-2, to the STD FAN position (OFF).

Change Over Selection. Heat pump systems change from heating to cooling by reversing the direction of Freon flow in the system. This change over is controlled by the CHANGEOVER (CO) output from the Control Unit (sometimes this is referred to as the reversing valve).

Most heat pump systems are designed to work normally in the heating mode and require a change over output for cooling. Set dipswitch SW1 position 3 to the CO/CL position (SW1-3 = OFF) for this type system. Check your HVAC system requirements for correct settings.

If your system requires changeover with heating, set SW1 position 3 to the CO/HT position (SW1-3 = ON).

Changeover Relay Operation: The changeover relay output stays ON after a heating/cooling call for the duration of the minimum off delay period. If another call occurs before the delay period expires, the CO relay will already be on and this avoids continuously cycling the CO valve on/off for each call.

TXB16 Control Unit HVAC System Outputs for Heat Pump Systems

Operating Mode	Changeover with Cool	Changeover with Heat
Manual Fan	G	G
Heating Stage 1	Y1, G	Y1, G, O
Heating Stage 1 + 2	Y1, Y2, G	Y1, Y2, G, O
Heating Stage 1 + 2 + 3	Y1, Y2, G, W1	Y1, Y2, G, O, W1
Cooling Stage 1	Y1, G, O	Y1, G
Cooling Stage 1 + 2	Y1, Y2, G, O	Y1, Y2, G
Emergency Heat	W1, G	W1, G

Control Unit Status LEDs

The Control Unit has LEDs on the circuit board to show **system status** and **relay output states**. When the relay output LED's are on, the relay is on.

Relay Output LEDs

LED	Function	Control Unit Output
H1	Heat stage 1 output (Heat stage 3 for HP systems)	W1
Fan	Fan output	G
C1	Compressor stage 1 output	Y1
CO*	Heat stage 2 output for Standard HVAC systems Changeover valve output for Heat Pump HVAC systems	W2 O
C2	Compressor stage 2 output	Y2

* The CO output is set by the system type switch (SW1) setting. When set to Standard systems the output becomes Heating Stage 2 (W2). When set to Heat Pump setting the output becomes the Changeover (reversing) valve output (O).

System Status LED

The Control Unit has a Status LED on the circuit board that will normally **flash on and off slowly** as a system heartbeat. The System Status LED can also show MRT/MOT states and X10 Communications.

Status LED MRT/MOT Indication

During the Minimum Run Time (MRT) period (default 6 minutes) after the beginning of a heating or cooling call and during the Minimum Off Time (MOT) period after a call ends (also default 6 minutes), the system status LED will **flash twice slowly** for each heartbeat. During the MOT period the compressor outputs are locked out to provide short cycle protection.

Status LED X10 Signal Reception or Transmission Indication

When the TXB16 is first powered up, the status LED will come ON steady, indicating power and the unit is running OK. When the X10 power line interface is connected **and an X10 signal is detected**, the LED will start flashing slowly as the normal system heartbeat.

If the X10 signal is lost, the LED will stop flashing and be ON steady. If this occurs, check the following:

1. Check that the X10 Power Line Interface module is powered and its LED is on. If not check the 110VAC circuit to be sure it is not switched off.
2. Check that the modular cable is plugged in securely on the X10 PLI and the TX16B
3. Verify that the correct "reversing" type modular cable is installed if not the factory cable or it has been changed before the problem occurred.
4. Replace module or cable as needed to restore X10 communications.

Any X10 Command Received. When the control unit receives *any valid X10 Command*, the Status LED will **flash twice rapidly.** Note that the LED on the X10 PLI module will also flash when X10 commands are detected.

X10 Command With Correct House Code Received. If the X10 command received is also addressed with the same house code as theTXB16 control unit, the status LED will **flash 4 times rapidly. This is a command for the TXB16!**

X10 Command Transmitted. When the TXB16 responds to a request for status or is set to AUTOSEND mode, it will transmit X10 commands for temperatures, setpoints and modes. Whenever a X10 command is transmitted by the control unit, the Status LED will **flash 4 times rapidly.**

X10 Power Line Interface

The TXB16 Control Unit has an X10 powerline carrier interface that allows X10 commands to be received and transmitted over the 110 VAC powerline. Commands from remote systems can change the setpoint temperature and mode of the thermostat. The Control Unit connects to the power line by an external X10 Powerline Interface Module. X10 commands received by the Control Unit are decoded to a new setpoint or a new mode and are sent to the WDU to update its display. When X10 commands are received, the WDU will switch it's display to show the updated information for three seconds and then return to the current temp display.

The thermostat has an X10 address called a House Code. There are 16 X10 House Codes referred to as the letters A to P.

X10 House Code Setting

New with the TXB16, the X10 House Code address, ***is now set from the Wall Display Unit.*** (If your unit includes X10 address dipswitch SW1, with positions 5, 6, 7 and 8, **ignore them as they are no longer used for address selection.** Set the desired house code by the following table. The unit comes with the X10 address set to 1 for House Code A.

To set the X10 House Code, enter the ***Setup Mode*** on the WDU by pressing the Mode button and the Fan button simultaneously. "SU" will be displayed on the WDU LCD display to indicate you are in the Setup Mode. Press the Mode button again to select "Ad" for X10 Address setting. Use the Up/Down buttons to select the desired X10 house code using the table below. When done wait for the setup screen to timeout and return to the current temperature display.

X10 House Code Address Setting Table

WDU Address	X10 House Code
1	A
2	B
3	C
4	D
5	E
6	F
7	G
8	H
9	I
10	J
11	K
12	L
13	M
14	N
15	O
16	P

X10 Command Decode Tables

The X10 communications protocol was originally designed to turn lights on and off or dim them. The TXB16 thermostats responds to X10 commands by **decoding** them into commands to change thermostat setpoints and modes. As such, there are two types of X10 commands that the TXB16 will respond to: the more simple **Unit Code commands** (32 commands), such as "A1 ON" or "A1 OFF" which are **receive**

only commands; and the more robust **Preset Dim commands** (512 commands), such as "A4 Preset Level 6%" which are bi-directional (received and transmitted by the TXB16).

The specific X10 commands that the TXB16 Control Unit can receive and how they are decoded into setpoints and modes is defined by a "Decode Table". The TXB16 includes 3 Unit Code decode tables, B, P, L and the Preset Dim Bi-Directional decode table. See the X10 Protocol manual #150-00200 for further information.

Unit Code Decode Tables
Unit Code Decode tables us the simple direct X10 commands sent by devices like the X10 mini or maxi controller, most all home automations systems and many security systems. They consist of messages with a House Code and Unit Code command sequences of House Code/Unit Code/Command such as A 1 ON (A= house code, 1 = unit code, On=command).
There are three Unit Code Command Decode Tables available in the TXB16, the P Decode table (default), the B Decode Table and the L Decode Table. Each has slightly different decode schemas.

- The P decode table is the primary and default table and is the same as used by the TXB16 thermostat.
- Non bi-directional TX15s used the B decode table.
- The L table is a special limited ON/OFF/SETBACK decode table for use with security systems that can have only one X10 House code and that must be shared with lighting and the thermostat.

Setting the Default Unit Code Decode Table.
The TXB16 is default set to the P decode table. You can set/change the decode table used by the TXB16 three ways.

1. Dipswitch SW1 position S4. Forced B Decode Table. Setting S4 to ON will force the B decode table to be active. Use this for compatibility with older TX15 thermostats. **When S4 is ON, no other decode table selection is allowed and will be overridden.** When set to OFF, ALO/AUO and preset dim commands are allowed.] NEW!

2. Use the Unit Code **All Lights On (ALO)** or **All Units Off (AUO) commands**. ALO will set the unit code decode table to "B" and AUO will set the decode table to "P". These changes are stored in EEProm memory and will not be lost by a power cycle.

3. Use the Preset Dim commands to select the decode table.

    a. Unit code 4, preset level 90% will set the decode table to "P"
    b. Unit code 4, preset level 94% will set the decode table to "B"
    c. Unit code 4, preset level 97% will set the decode table to "L"

    These changes are also stored in EEProm memory and will not be lost by a power cycle.

Unit Code and Preset Dim Command Control
Unless otherwise turned off by preset dim commands, both Unit Code and Preset Dim commands can be used simultaneously. Unit Code commands can be inhibited by a preset dim command (Unit 4 55%). Preset Dim commands can also be inhibited by a Preset Dim command (Unit 4 61%). Note that the Preset Dim Command "Preset ON" (Unit 4 58%) command is always enabled.

Other Preset Dim Control Commands
The Preset Dim command set contains many other control options. Refer to the X10 protocol manual for details on these commands. They are listed below.

- Unit Code Commands ON/OFF
- Preset Dim Commands ON/OFF
- Acknowledgement Mode ON/OFF
- Echo Mode ON/OFF
- Safe Mode ON/OFF
- Autosend Mode ON/OFF
- Dual Setpoint Mode ON/OFF
- Test Mode ON/OFF

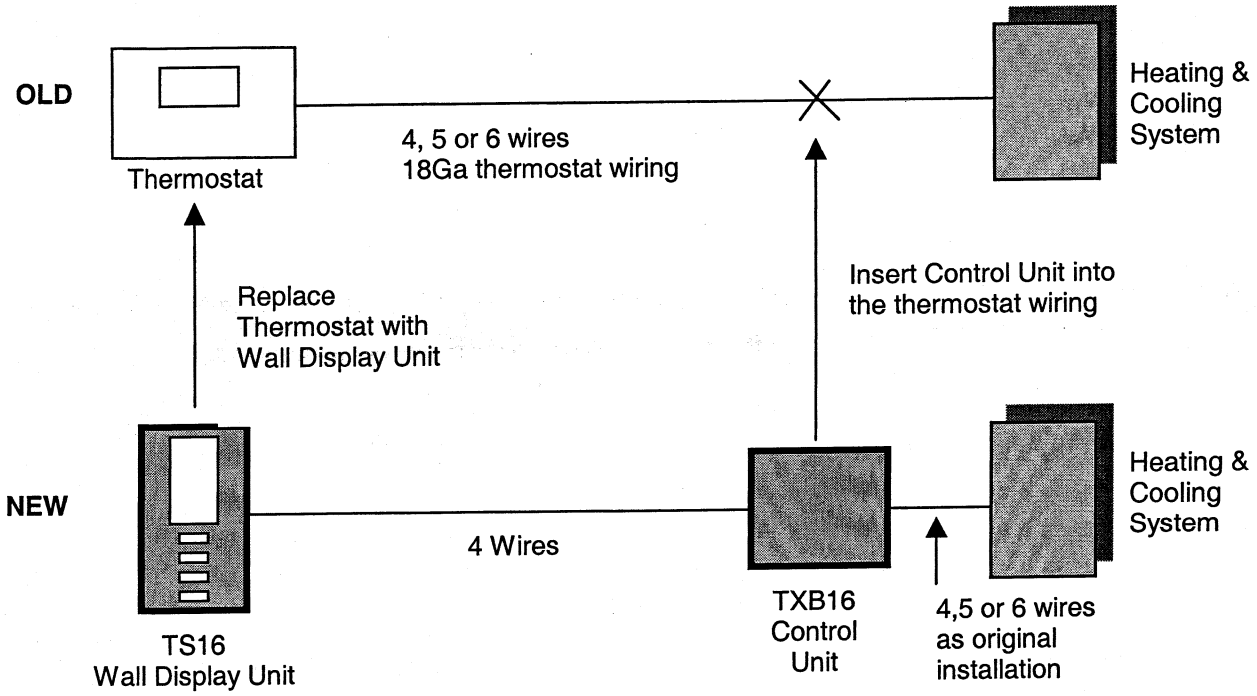
STOP

Before proceeding with removing an existing thermostat and installing the TXB16, Read the following important steps.

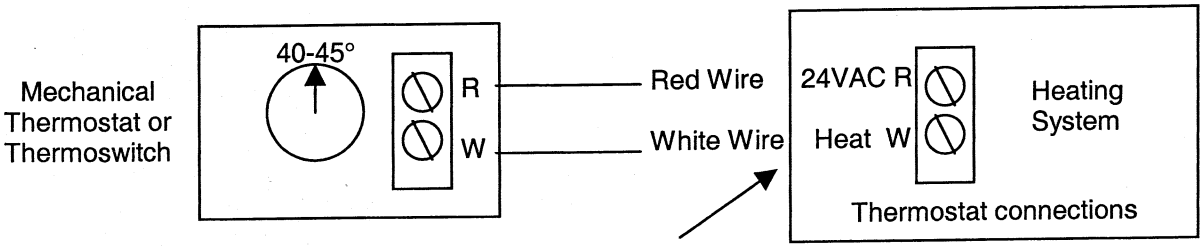
1. **Record existing wiring information on the enclosed wiring form.**
2. **Perform the TXB16 bench test**
3. **Check WDU wiring BEFORE applying power to control unit.**
4. **Be sure to install a freeze protection device as required.**

Installation Overview

Standard thermostat wiring vs TXB16 in retrofit applications.



Freeze Protection.
In cold climates that require the heating system to be used for building freeze protection, a mechanical backup freeze protection device MUST be installed on the heating system. This can be a simple mechanical heating thermostat or a preset thermoswitch installed in the heated area.



Wire across Heater R/W terminals.

TXB16 Wall Display Unit Installation

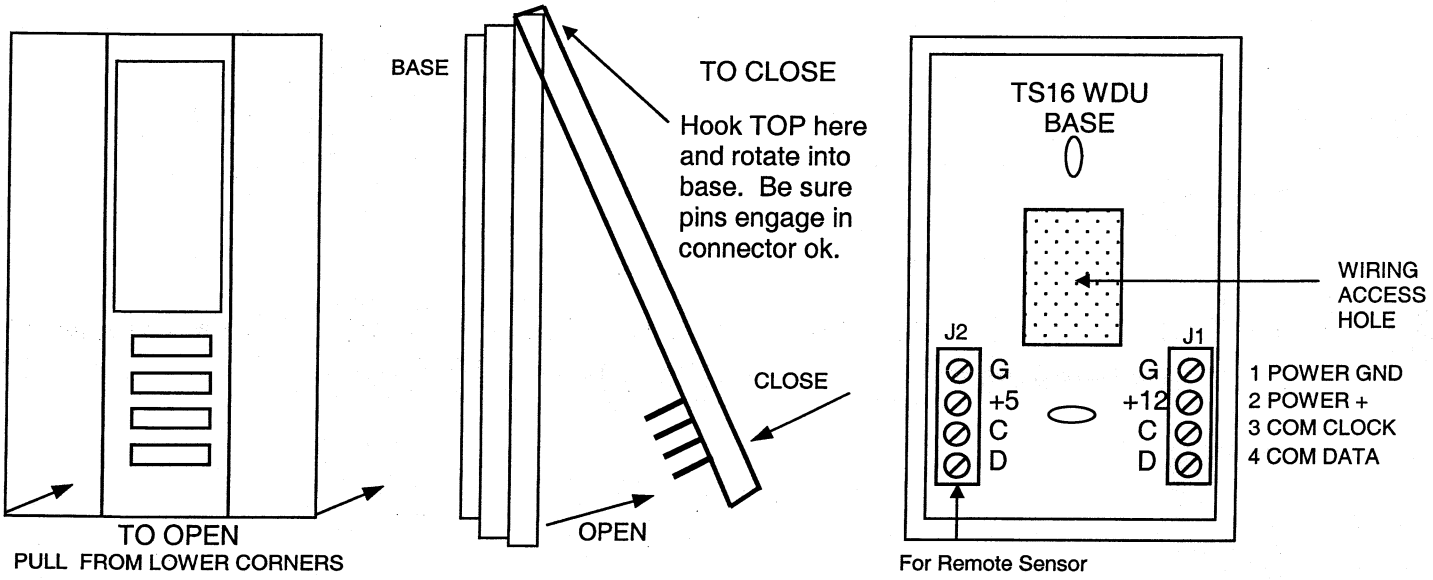
WDU Location Choose a location that best represents the temperature of the area to be controlled. Avoid locations that are subject to drafts, from doors and windows, or areas with direct sunlight exposure.

WDU Mounting Route the wires to the WDU through the access hole in the back of the case. Mount the WDU to the wall with the screws and anchors provided. Be sure to plug any large access hole in the wall with sealer or insulation to prevent wall drafts from affecting WDU operation.

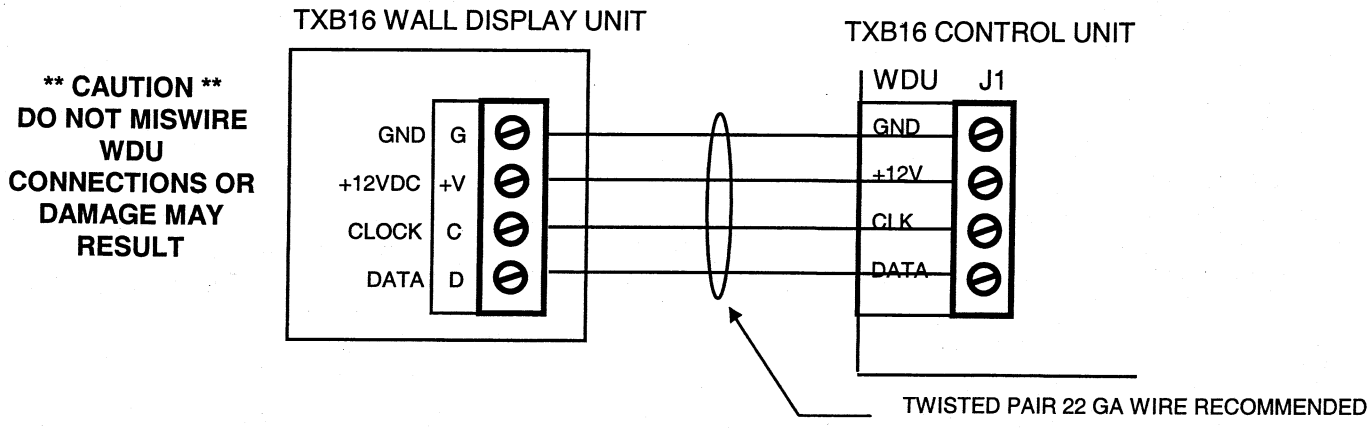
WDU Pre-wiring The recommended wiring to the WDU from the Control Unit should be a two twisted pair cable, 24 GA minimum. Cat 3 or 5, 4 pair cabling is acceptable. In retrofit applications the existing thermostat wiring (a least 4 wires) may be adequate. However, such non-twisted wiring may be subject to interference due to noise from adjacent wiring or other sources.

Wiring to the Wall Display Unit

OPENING AND CLOSING THE WDU CASE



WDU WIRING DIAGRAM



Remote Sensor Wiring

The TS16 WDU has an addition connector, J2, on the WDU base for connection of an external remote temperature sensor. Follow the wiring diagram with the remote sensor to connect to the WDU.

TXB16 Control Unit Installation

Location and Mounting

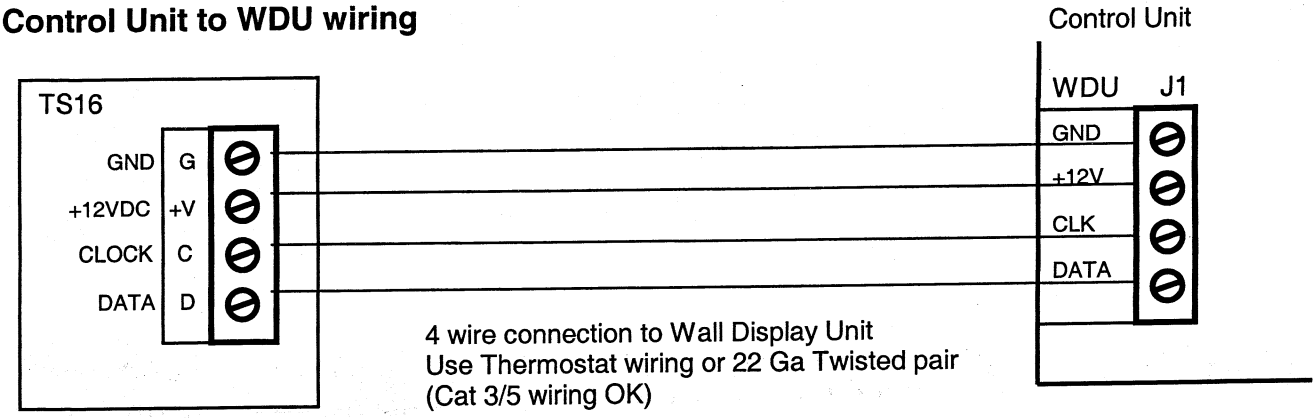
Install the TXB16 Control Unit in a protected, convenient, INDOOR location near the HVAC system or in a service accessible area such as an equipment closet or garage.

Mount the Control Unit in a vertical position on a wall or sturdy structural member. The unit may be mounted on the HVAC system but care should be taken to avoid the hot burner section or high vibration areas.

Control unit wiring

The TXB16 HVAC Control Unit is connected to the HVAC system and to the Wall Display Unit as well as the X10 communication interface and power connections.

Control Unit to WDU wiring



Control Unit to HVAC System wiring

Electrically, the Control Unit looks like a standard thermostat to your HVAC system. All connections to the HVAC system are made at the normal thermostat connections on the HVAC unit.

Control Unit Setup. You are advised to refer to your HVAC system's documentation for specific information on its thermostat connections and setup requirements. ***You must know the following:***

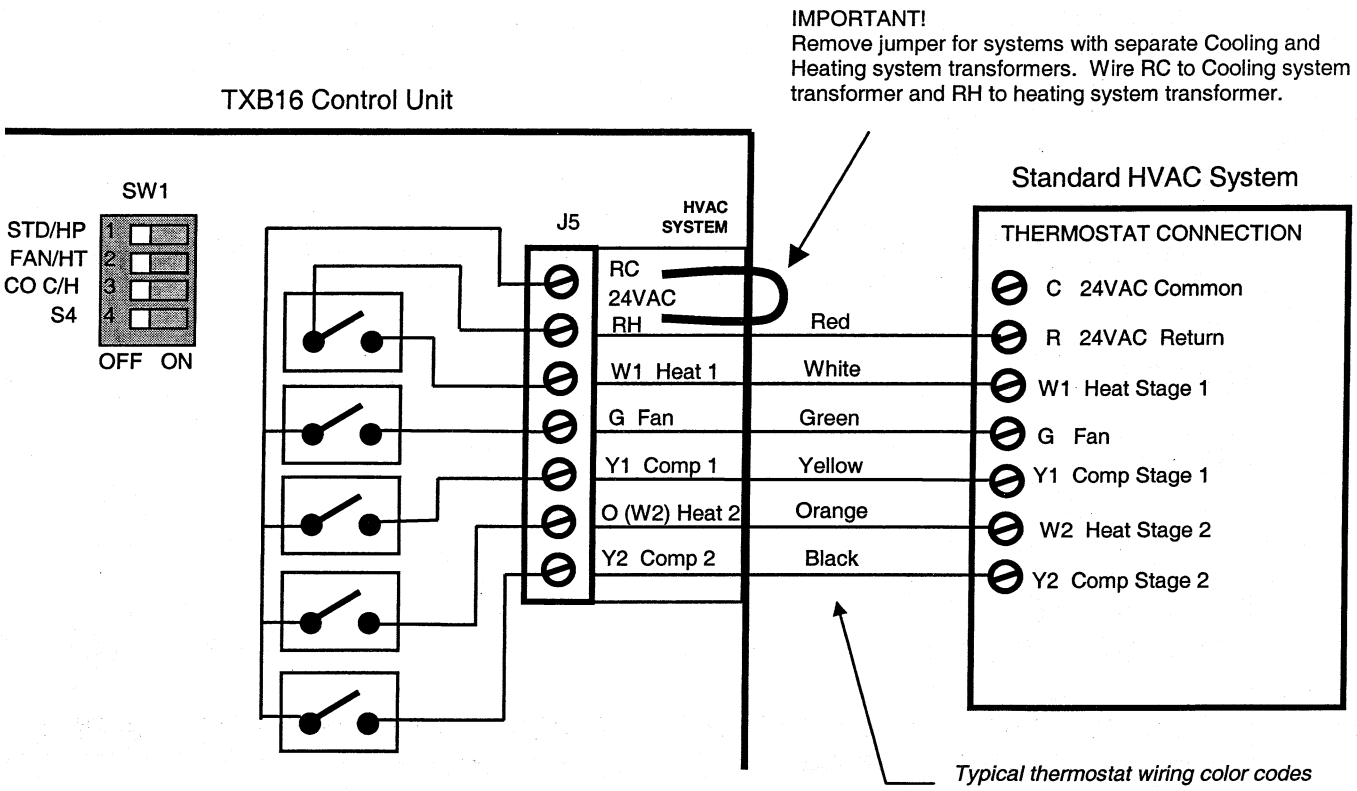
1. HVAC system type: Gas, Electric or Heat Pump
2. Fan requirement:
    a. No fan with Heat (Gas heat)
    b. Fan with Heat (Electric heat)
3. For Heat Pump systems: Changeover valve type:
    a. Change over with cool (O thermostat connection)
    b. Changeover with heat. (B thermostat connection)

Note on retrofit wiring. You may note (and be sure to note on the wiring form) that you have additional wires when you disconnect your old thermostat. Usually these wires are for auxiliary functions such as filter or trouble indicators. For Heat Pump systems there may be emergency heat (EH) wiring or both O and B changeover connections. These wires are not used in the TXB16 installation and in most cases these extra wires are not required for normal HVAC system operation.

Refer to the following HVAC wiring diagrams for the type of HVAC system that you have, Standard Gas/Electric or Heat Pump.

HVAC System Wiring – Standard HVAC Systems

Diagram 1 - Standard Gas or Electric System Wiring



STANDARD HVAC SYSTEM SETUP

Dipswitch SW1 Setup

1. Set SW1-1 (position 1) to the STD position. (Off or to the left)
2. Set SW1-2 (position 2) to the correct setting for your HVAC system.
   a. **Gas furnaces** do not require fan outputs for heating calls. Set SW1-2 to the Off or to the left.
   b. **Electric furnaces** do require fan outputs for heating calls. Set SW1-2 to the On or to the right.
3. SW1-3 (position 3) is not applicable to standard systems, leave Off or to the left.
4. SW1-4 (position 4) is for X10 Decode Table B select.

HVAC System 24VAC Connections

If you have an integrated heating/cooling system with a single 24VAC transformer, do NOT remove the red jumper wire and connect the system red wire to either RH or RC. This is typical of most central systems.

If you have a separate heating and cooling systems with separate transformers, remove the red jumper and wire the heating system red wire to RH and run the cooling system red wire to RC.

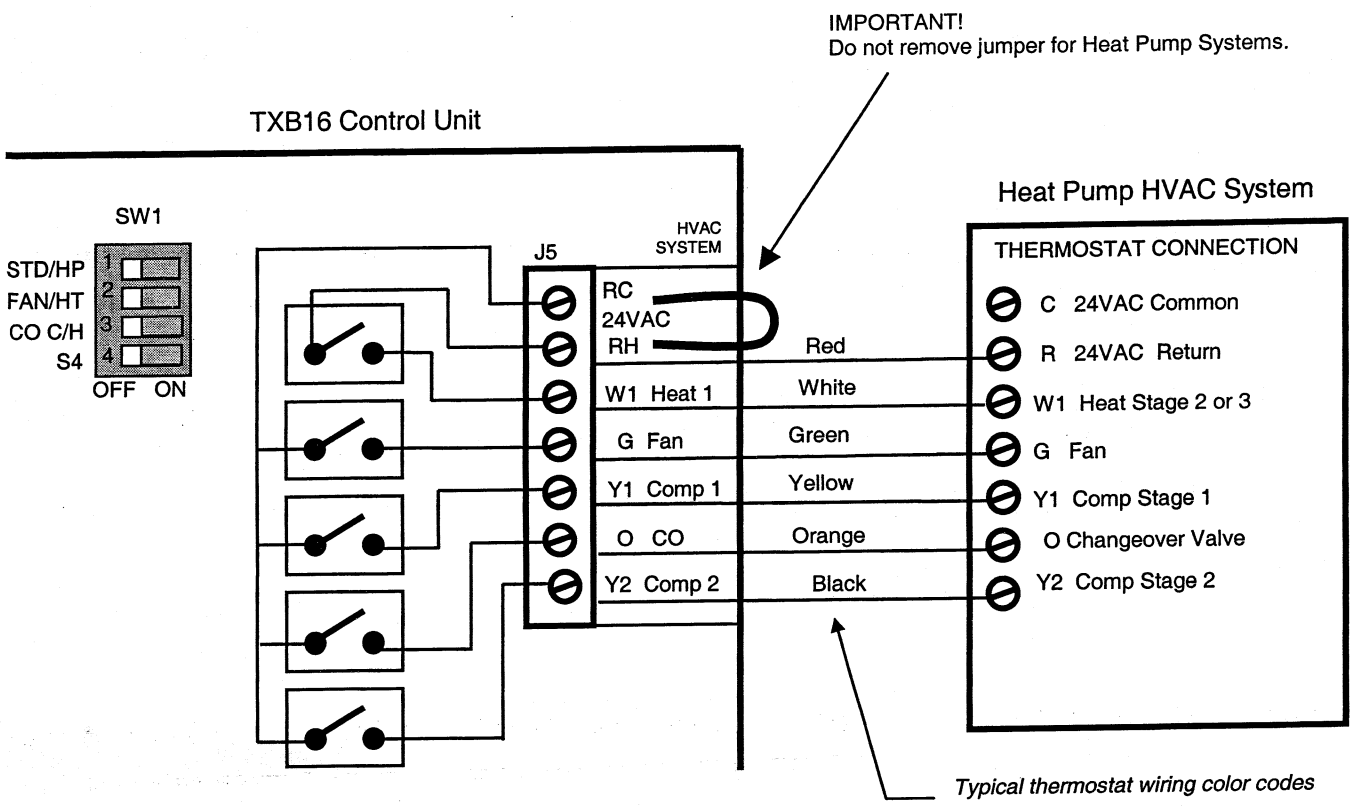
Standard HVAC Systems Multistage Outputs

Single Stage systems use W1 for heating stage 1, and Y1 for cooling stage 1.

Two Stage Heating systems use W1 for stage 1 and O (W2) terminal for stage 2 heating.

Two Stage Cooling systems use Y1 for stage 1 and Y2 for stage 2 cooling.

Diagram 2 - Heat Pump System Wiring



HEAT PUMP HVAC SYSTEM SETUP

Dipswitch SW1 Setup

1. Set dipswitch SW1-1 (position 1) to Heat Pump position. (On or to the right)
2. SW1-2 (position 2) is not used for Heat Pumps. Leave Off or to the right.
3. Set SW1-3 (position 3) to the correct setting for your Heat Pump system.
   a. For systems with changeover with cooling, Set SW1-3 to Off or to the left.
   b. For systems with changeover with heating, Set SW1-3 to On or to the right.

** If you are not sure of the correct changeover setting, select the CO/C position. Most HP systems use this configuration. ***If you get heat when you expect cool, change the setting to CO/H.***

4. SW1-4 is for X10 B Decode Table select.

Heat Pump Multistage Outputs

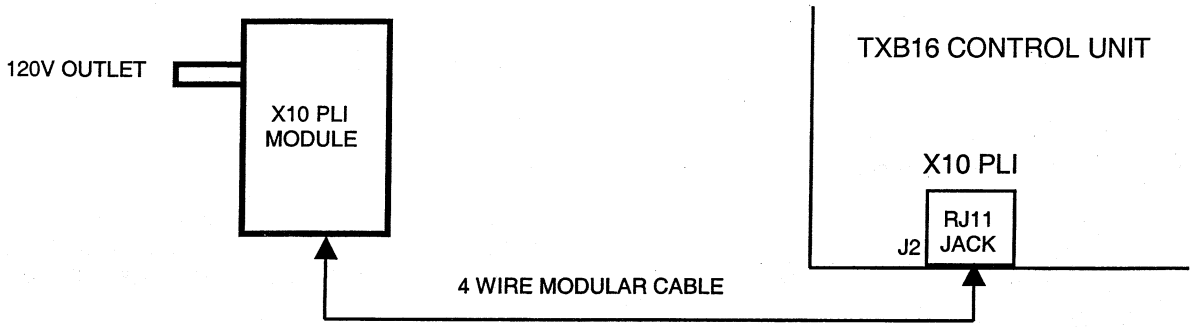
Single Stage Compressor Systems use Y1 for stage 1 heating/cooling, and W1 for stage 2 heating (heat strips).

Two Stage Compressor Systems use Y1 for stage 1 and Y2 for stage 2 heating/cooling, and W1 for stage 3 heating (heat strips).

NOTE: The Changeover (reversing) valve setting (SW1-3) determines whether heating or cooling is output from the control unit and the HVAC system. Be sure this is set correctly.

Wiring to the X10 Powerline Interface Module

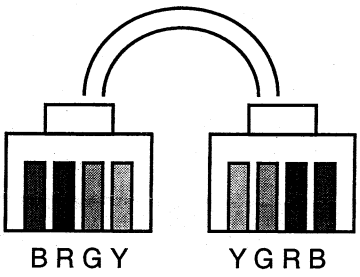
The X10 interface on the Control Unit is the RJ11 jack, J2. It is connected to an X10 power line interface module, Model PSC05 or TW523, by the **four (4) wire** modular phone cable provided.



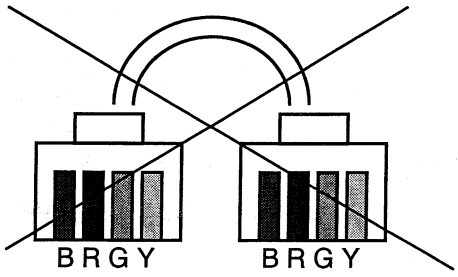
IMPORTANT NOTE: ***Use the Modular Cable Provided.*** **If you do not, be sure the cable is the correct type. The Cable must be 4 wire (NOT 2), and reversing.**

If you are having X10 communication problems or in doubt about the cable, check the cable with the simple inspection shown below.

Place the ends of the cable side by side and verify the color codes of the conductors are in **reverse** order as shown here.



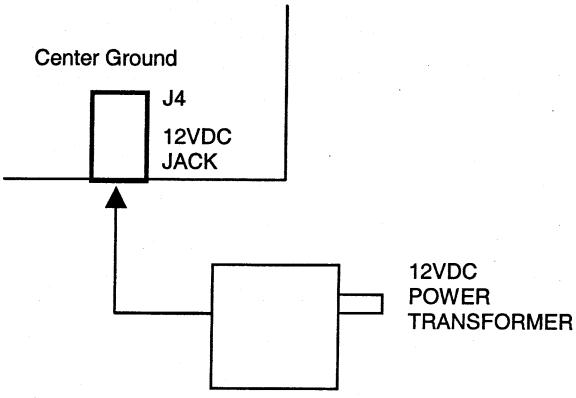
CORRECT CABLE WIRING



INCORRECT CABLE WIRING
DO NOT USE THIS CABLE

Power Connection

The TXB16 Control Unit requires 12VDC, 200ma max. Connect the provide transformer to jack J4.



NOTE! Be sure to plug the transformer into an outlet that is NOT switched

It is strongly recommended that you hook-up and run a simple bench test before installing the TXB16. Not only will this save you time in system checkout but will also familiarize you with the thermostat's operation.

THERMOSTAT BENCH TEST

1. Connect the Wall Display Unit to the Control Unit with a short (12 inch) 4 wire cable.
2. Before power up, set the Control Unit dipswitch, SW1, to ALL OFF
3. Connect the 12VDC transformer to the Control Unit.
4. Plug the transformer into an 110VAC outlet and apply power. Verify Control Unit Status LED is blinking.
5. Verify the WDU display comes on and shows the current temperature.
    a. If no display and backlights are not on, check wiring and power at the Control Unit.
    b. If a "CF" display is shown on the WDU, double check your wiring to the control unit.
    d. Do not proceed until the current temperature is displayed on the WDU.
6. With the current temperature displayed on the WDU, we have verified communication between it and the Control Unit is OK. Any communication problems will result in a "CF" (Communications Failure) display on the WDU.
7. Press the Fan button on the WDU. The Control Unit's Fan LED and relay should turn on.
8. Press the Fan button again. The Fan LED and relay should turn off.
9. Press the Mode button until the WDU is showing "H" for Heat Mode.
10. Press the Setpoint Up button until the setpoint is above the current temperature. The Heat LED and relay should come on.
11. Press the Mode button until the WDU is showing "O" for OFF. The Heat LED and relay will turn OFF.
12. Power cycle the Control Unit to reset the minimum off timer. (remove power for a few seconds)
12. Press the Mode button until the WDU is showing "C" for Cool Mode.
13. Press the Setpoint Down button until the setpoint is below the current temperature. The Cool and Fan LEDs and relays should turn on.
14. Press the mode button until the WDU is showing "O" for OFF Mode.
15. All LEDs and relays should turn off.
16. When you have successfully completed all these tests, you have verified that the TXB16 is working correctly.

X10 QUICK TEST

Requires an X10 Mini-Controller or Maxi-Controller or a *known good source* of X10 signals.

1. With the TXB16 connected as above, proceed with connecting the X10 Interface Module.
2. Connect a four wire modular phone cable to the Control Unit.
3. Connect the other end of the cable to the X10 Interface Module.
4. Plug the X10 Interface Module into a 110VAC outlet. The module's LED should be ON.
5. Plug an X10 Controller in the outlet.
6. Set the House Code on the X10 controller to match the TXB16 Control Unit (Example: House Code A or 1 on the WDU).
7. Send Unit code ON and OFF commands from the X10 controller and verify that the WDU display shows the correct response to each command sent per the X10 Decode Tables
8. Verify the TXB16 Status LED is showing X10 commands being received. You should see 4 rapid flashes if the address is correct, only 2 if the command is not address correctly.
9. The LED on the X10 Interface Module should blink with each command sent from the X10 controller.
10. If you have difficulty receiving X10 commands, double check the modular cable, the X10 Interface Module and the House Code settings. .
11. If the TXB16 responds properly to the X10 commands, proceed with installation.

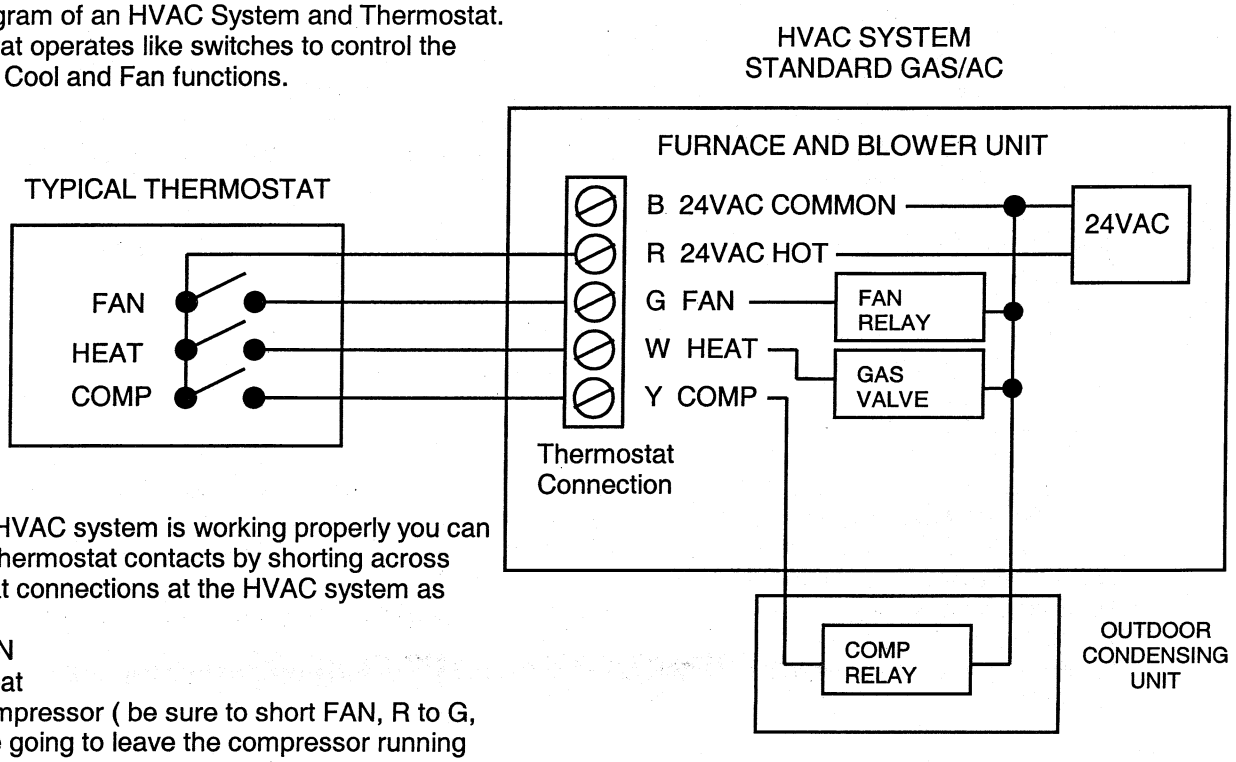
It is recommended that you install the TXB16 and then rerun these quick tests BEFORE you connect the controller to the HVAC system. You will be confident that the TXB16 is working correctly before you attempt to interface to the HVAC system.

HVAC SYSTEM TESTING

The TXB16 Control Unit connects to the HVAC system at the normal thermostat connections on the HVAC unit. Standard thermostat control of HVAC systems consist of 24VAC contact closures in the thermostat. You can verify that your HVAC system is working correctly by duplicating the contact closures by shorting across the proper terminals at the HVAC system's thermostat connection. Refer to the following HVAC system example.

HVAC System Example

Simplified diagram of an HVAC System and Thermostat. The Thermostat operates like switches to control the HVAC's Heat, Cool and Fan functions.



To verify the HVAC system is working properly you can simulate the thermostat contacts by shorting across the thermostat connections at the HVAC system as follows:
R to G for FAN
R to W for Heat
R to Y for Compressor (be sure to short FAN, R to G, also if you are going to leave the compressor running for longer than a few seconds to test)

You can also verify the HVAC operation at the TXB16 Control Unit by placing a wire jumper across the Control Units HVAC System terminals as follows (with the HVAC system connected to theTXB16):

For Standard HVAC systems, jump across J4, HVAC System terminals as follows:

FAN operation: Jumper across R and G (Fan) terminals.
HEAT operation: Jumper across R and W (Heat) terminals (Fan is not usually necessary for gas furnaces).
COOL operation: Jumper across R and Y (Compressor) and G (Fan) terminals.

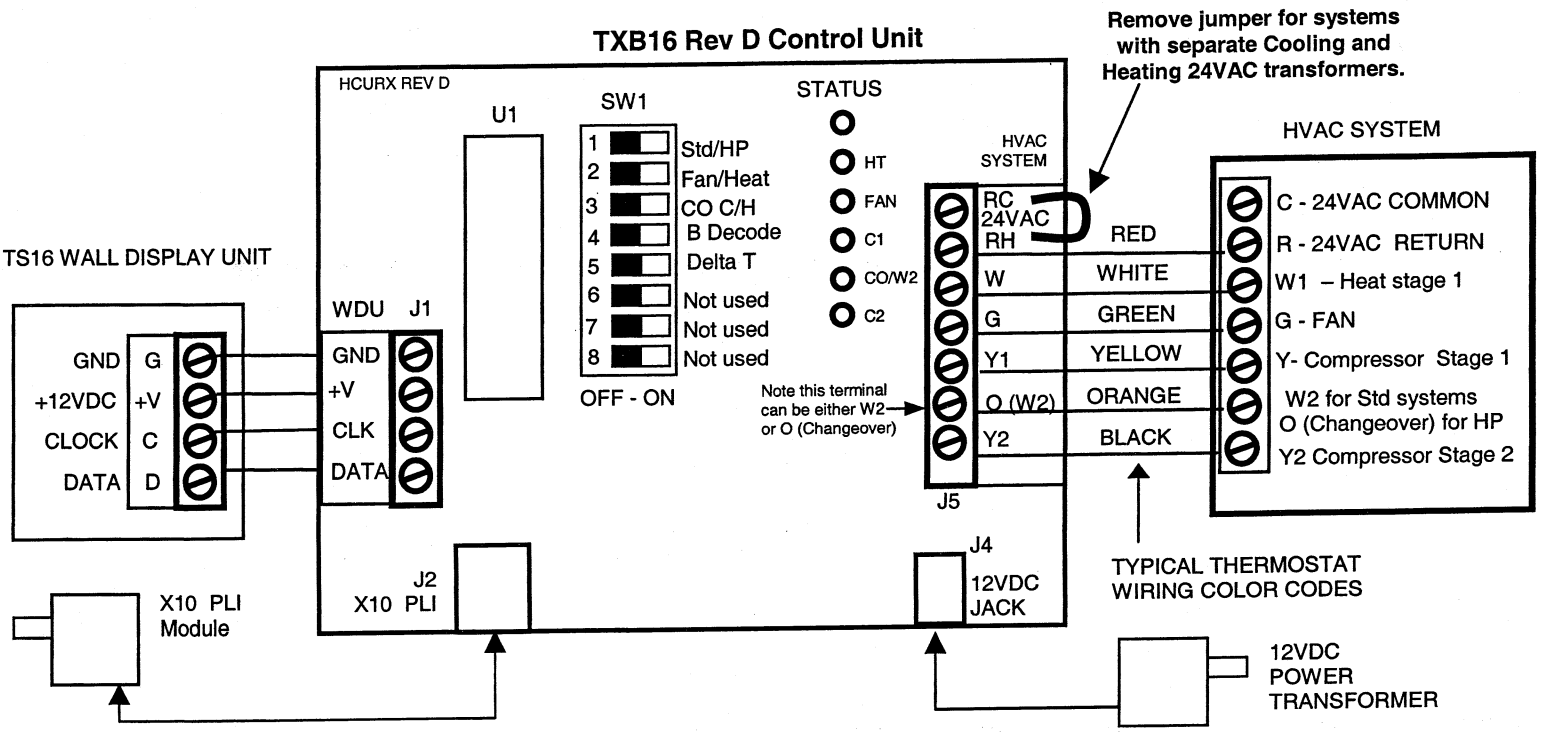
For Heat Pump systems with Changeover for cooling, jump across J4, HVAC System terminals as follows:

FAN operation: Jumper across R and G terminals.
HEAT Stage 1 operation: Jumper across R and Y (Compressor) and G (Fan) terminals.
HEAT Stage 2 operation: Jumper across R and W (Heat Strips) and G (Fan) terminals.
COOL operation: Jumper across R and Y (Compressor) and O (Change Over) and G (Fan) terminals.

If the Control Unit's output LEDs are ON and you suspect you are not getting an output from the relays, perform the above shorting test to verify that the HVAC system is working OK. If the HVAC system responds correctly to the shorted terminals, then the output relay is suspect.

RCS

TXB16 X10 Thermostat
WIRING DIAGRAM



DIPSWITCH SW1 SETTINGS
(Black is switch position)

SW1-S1 STANDARD OR HEAT PUMP HVAC SYSTEM TYPE SELECTION

HVAC systems can be either Standard Gas/Electric systems or Heat Pump systems.
Set SW1-1 to STD SYS (OFF) for Gas/Electric systems (default).
Set SW1-1 to HP SYS (ON) for Heat Pump systems.
Note: This switch setting changes the output of the O terminal on the HVAC terminal block. For Std systems the output is 2nd stage heat (W2). For HP systems the output is changeover valve (O).

SW1-S2 GAS or ELECTRIC SYSTEM FAN TYPE SELECTION

For Standard Gas furnaces, SW1-2 should be in the OFF position. (default)
For Electric heat furnaces, SW1-2 should be in the ON position. (Provides fan with heat calls)
This switch in not used for Heat Pump systems. Leave in OFF position.

SW1-S3 CHANGEOVER WITH COOLING OR WITH HEATING SELECTION

For Heat Pump systems only! This switch in not used for Standard Systems. For Std systems, leave in the OFF position.
Heat Pump systems require a change over (sometimes referred to as reversing valve) output to switch between heating and cooling. Check your HVAC system documentation to determine what your system requires.
For changeover with cooling, SW1-3 should be set to OFF position. (Default)
For changeover with heating, SW1-3 should be set to ON position.

SW1-S4 B Decode Table Select

When this switch is ON, it forces the X10 B decode Table to be active. Use this switch to be compatible with older TX15 thermostats. Must be OFF to change decode table by All lights ON or All Units Off or Preset Dim commands.

SW1-S5 Delta T Mode Select
S5 = OFF selects normal 1 degree from setpoint mode of operation.
S5 = ON selects +/-1 degree from setpoint mode of operation (provides greater temp swing and less cycling)

Sw1-S6 to S8 Not used on this version.